

theatre," at one side of a small area of smooth level bottom-land, a sloping bank rises rather steeply to a height of perhaps thirty feet; along this slope are three or four terraces, not large enough to be of any use for tillage. There is nothing in the eastern part of the United States known to be of Indian origin with which these may be properly compared.

The author describes the various kinds of burial works of the Indians, and compares the numerous cairns found in Massachusetts with Indian stone mounds, but most of these were very much larger than any cairns supposed to be constructed by the Norse. The Indian graves contain skeletons and relics. The stone cairns, the cairns in question, are called graves because they answer, in every particular of size and situation, to those mentioned in different sagas, and are in the midst of various other remains which must be attributed to the Northmen; and yet, in all that have been examined there has not been found the slightest trace of bone or any object which shows the least indication of being artificial. This, however, is only negative evidence; the same statement is true in regard to the graves of Iceland and Greenland; and not only of the graves in these countries, but also of the house-sites. It is also apparent that they differ from Indian graves even more in the manner of their interior construction than in their outward appearance.

A. C. H.

### PROGRESS OF SCIENCE TEACHING.

THE first report of the newly organised Board of Education has now been published. It consists of three volumes—the first contains the general report of the Board, the second is concerned only with secondary, and the third volume only with elementary education. A very important part of the second volume comprises the reports of the inspectors of the South Kensington branch of the Board of Education, who have charge of the teaching of science and art in different parts of the country. Without exception the inspectors tell a gratifying story of better equipment, improved methods, and saner ideals in the science schools visited by them. But though there has been a decided step forward there is still much to be accomplished and plenty of need for the best energies of both inspectors and teachers.

The reports are full of interesting details, it is true, yet certain broad questions touched upon by nearly every inspector are likely to be of greater general interest. The first of these the senior chief inspector, Mr. Gilbert Redgrave, refers to at some length. Readers of NATURE are already quite familiar with it—the unsatisfactory condition, that is, of the preliminary education of science and technical students in all parts of the country. Mr. Redgrave says: "I find that in a very large number of cases the work of the teacher in an evening class under this Board is crippled and rendered ineffective owing to the backward state of many of the students who enter the classes, and who are really only qualified for the evening continuation school." As Dr. Ball points out, in his report on the work of the South-Western district, the science inspector has no connection with public elementary education and consequently no means of officially acquainting himself with what provision is made for the teaching of science in the elementary school, and there can be little doubt that it is this want of continuity which is very largely to blame for the disparity between what an ex-standard scholar actually knows and what he should be acquainted with if he is to benefit by the instruction of the science class or technical school. Fortunately, local endeavour is doing something to remedy this evil. Mr. Hugh Gordon tells of an arrangement in the county of Durham by which, during the year with which his report is concerned, the County Council refused to grant aid on the attendance of students at a class in a subject unless the students could produce satisfactory evidence to show they possessed the necessary preparatory knowledge, or would attend concurrently such other classes as the teacher considered desirable. Similar instances could be cited, but this example will serve to exemplify what attempts are being made to cope with a real danger to our system of national technical education.

Another subject which very properly takes an important place in most of the reports is the need of practical instruction in all science teaching. There has, the reports show, been a decided improvement in the amount and character of the practical work in all branches of science, except, perhaps, in the case of physiography. In order to enable teachers to illustrate their lessons with properly prepared experimental demonstrations,

and to foster individual practical work for their students, they must be given time in which to prepare such lessons. We are glad to see that Mr. Harold Wager calls prominent attention to this fact in his report on the Yorkshire division. He says: "The governors or managers of many of these schools have not yet fully appreciated the fact that teachers of practical science subjects require a considerable amount of time for the preparation of the experiments for their lessons beyond the time actually devoted to teaching. The necessary preparation for a good practical lesson in the laboratory is no light task, and if the work is to be done properly the teacher must have time for it."

Some progress in the direction of co-ordinating the work of the numerous local authorities for education has been made, but there still seems to be considerable misapprehension as to the precise limits of the sphere of influence of each committee or other governing body. It is gratifying to see that broad-minded counsels have prevailed in many centres, with the result that the very large amount of energy thereby saved has been devoted to the improvement of the local supply of scientific and technical instruction. Mr. Redgrave sketches a plan by which the different schools may work together in a satisfactory and harmonious manner. "The Technical School under the Town Council should be a day school for students who have passed through a course of two or three years in a School of Science, which might be conducted by the School Board, and who may desire to qualify themselves for good positions in industrial or commercial pursuits. The School of Science managed by the School Board would in each case be the preparatory school for the Technical School, but it would also provide an education complete in itself for those who leave school at the age of fifteen or sixteen. The evening classes at the Technical School should be classes in connection with the Board, or with the City and Guilds of London Institute, while the evening classes under the School Board should in all cases be those of the evening continuation school, and students should be encouraged to prepare for the classes under the Technical Instruction Committee by a course of study in the evening continuation school." Similar plans have, indeed, been already tried with great advantage in several centres, and it is much to be desired that some such sensible system of co-operation should be universally adopted.

Only part of the science teaching given in secondary schools comes within the purview of the reports under consideration, that, namely, which takes place in secondary schools receiving financial aid from the Board of Education. Mr. Buckmaster deals almost exclusively with this part of the work of the South Kensington branch of the Board. Among other matters which his report makes clear is the fact that there is likely to be some difficulty in the future in those cases where the inspector of the Board of Education and the organising secretary of a County Council Technical Instruction Committee come to different conclusions about a school after inspecting it. As Mr. Buckmaster says, "even in a county area cases may occur where the County Technical Committee will deprecate criticism on the schools it has selected as recipients of its grants."

The points of interest in this very valuable volume have been by no means exhausted by this brief notice. The chief topics only have been passed in review; the interested reader must be referred to the reports themselves for a more detailed account of a vitally important subject.

### UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

DR. ARTHUR ROBINSON has been appointed professor of anatomy at King's College, London.

Science states that in an address to the students of Colorado College, Dr. D. K. Pearsons, of Chicago, announced that on January 1, 1901, he would make the college a gift of 10,000*l.* towards the cost of completing the new scientific building now in course of construction.

At the close of his rectorial address at Aberdeen University on Tuesday, Lord Strathcona expressed his willingness to contribute 25,000*l.* to the University if within a year 50,000*l.* more were raised to complete the buildings and properly equip the University. Mr. Charles W. Mitchell has telegraphed to the Principal that he will be responsible for the whole of the present debt on the University buildings if it does not much exceed 20,000*l.* Mr. Mitchell is a son of the late Dr. Charles Mitchell, who was a liberal benefactor of the University.

A BASE measuring apparatus, which has been perfected in connection with the summer school work of the Civil Engineering Department of the Massachusetts Institute of Technology, has recently been tested by the Coast and Geodetic Survey in Washington. Such satisfactory results have been already obtained that the apparatus is about to be used in the important Lampasas Base in Texas. Prof. Burton, of the Institute, under whose direction the apparatus has been worked out, has been invited to accompany the expedition, which is to make a careful trial of the method in the field and upon extended exact work. The apparatus represents the final results of thesis investigations by several graduates of the course in civil engineering who have worked upon it in successive years. One part of the apparatus maintains a constant tension in the steel tape while in use. Another part of the apparatus determines very accurately the mean temperature of the tape by measuring its electrical resistance by means of a special form of thermophone devised by two graduates.

### SOCIETIES AND ACADEMIES.

#### LONDON.

**Physical Society, December 14.**—Meeting held at the Royal College of Science (by invitation of Prof. Rücker), Principal O. J. Lodge, President, in the chair.—A paper on electric inertia and the inertia of electric convection was read by Prof. A. Schuster. Calculations of self-induction are based on the assumption that the currents which traverse a conductor fill it continuously, the flow being treated as that of an incompressible liquid. The assumption is generally recognised not to hold in the case of electrolytes where electricity is conveyed by a number of irregularly distributed ions. In the immediate neighbourhood of such an ion, the magnetic field is many times greater than that calculated on the supposition of continuous distribution, and hence the total magnetic energy is underestimated. What is universally recognised in the case of electrolytes must also be conceded when the current is conveyed by a gas, and the idea is gaining ground that even in solid conductors the current consists of positive and negative electrons moving with different velocities. It is the object of the paper to calculate the additional terms which become necessary for the evaluation of self-induction, and to discuss the possible cases in which the corrections may effect experimental results. The mathematical investigation shows that it is necessary to add a correcting term containing a quantity which may conveniently be called electric inertia. The author has calculated the numerical value of this quantity in the case of a solid conductor, and finds it to be about  $2 \times 10^{-12}$  C.G.S. units. It is of the dimensions of a surface. The experiments of Hertz have proved that if electric inertia exists, it must be less than  $18 \times 10^{-8}$ . In the case of liquids and gases, the electric inertia of the moving ions becomes much more important, and the calculation of self-induction by the ordinary processes gives erroneous results. The introduction of a term representing inertia alters the general equations of electric motion, and the author has applied his modified theory to Leyden jar discharges, the electrodeless discharges of J. J. Thomson, and the electromagnetic theory of light. In the case of electrodeless discharges in a vacuum globe, it is suggested that the absorption of energy may not only be due to the conductivity of the gas, but also to the inertia which it possesses.—A paper on magnetic precession was then read by the same author. The most delicate method of investigating the influence of electric inertia is based on the electromotive forces introduced by the motion of conductors carrying electric currents. If electricity behaves like a body possessing inertia, the rotation of a body through which currents pass should affect the flow of these currents in the same manner as the earth's rotation affects the direction of currents of air. If the earth's magnetism is due to electric currents, it is interesting to see if the effects of inertia can explain the secular variation. The investigation shows that a magnetic precession of the character of the secular variation would be produced, but that the precession would be very much slower than the variations actually observed. The subject is worked out mathematically, dealing first with the case of currents in a spherical shell, and then extending the result to the case of a solid sphere. The calculated period of a cycle comes out as  $7 \times 10^4$  years. If the currents are confined to a thin slice of the earth, the time would be reduced to about  $14 \times 10^6$  years. To produce the actual period of the

secular change, the current sheet would have to be of molecular dimensions. This suggests the possibility of the phenomenon of secular variation being rather of a molecular than a molar character. Prof. Rücker congratulated the author upon his attempt to solve the problem of terrestrial magnetism, and expressed the hope that further calculation would throw more light upon this difficult subject. Mr. Blakesley asked if the time of the secular variation would be altered if the interior of the earth were liquid or solid. The chairman observed that the precession was rapid in the case of a thin layer of gas, and mentioned J. J. Thomson's notion that the electrons were thrown off by centrifugal force and formed a molecular layer. Hertz, in his experiments on electricity, had looked for material inertia besides electromagnetic inertia. In the present theory the distinction disappears, and there is only one inertia, and that electromagnetic. Prof. Ayrton said if the two forms of inertia were electromagnetic, he would like to know why, in detecting the second form, it was necessary to associate it with an absorption of energy, as in the case of an electrodeless discharge. In the case of ordinary self-induction there is no absorption of energy, and if there is absorption in the second form, and if they are both electromagnetic, he would like to know the difference between the two. Prof. Schuster, replying to Mr. Blakesley, said that if the interior of the earth were treated as liquid, the period of the cycle would be about one hundred times less. In reply to Prof. Ayrton, he said he had only cited one experiment to show that a phenomenon, explained by the gas being a good conductor, could also be explained by its electric inertia. It was impossible to say in general whether self-induction caused an absorption of energy or not.—Prof. A. W. Rücker read a paper on the magnetic field produced by electric tramways. Taking the case of a tramway in which the current flows along a trolley wire from the power-house, and returns partly through the rails and partly as earth currents, the author has shown that the vertical disturbing force at any point is due to the currents in the feeders and rails, and that the earth currents affect the horizontal force only. Experiment shows that it is chiefly the vertical force instruments which are affected by the establishment of an electric railway, and since this disturbance is due to the wires and rails it is impossible for an observatory to be protected by rivers or other natural features of the district. A preliminary investigation is based on the assumption that the trolley wires and rails are insulated conductors, and that a fraction of the whole current returns along the rails to the generator. The effect of the railway at a distant point is due to the difference of the current in the trolley wire and the hypothetical uniform rail current, the effect of which at the point considered is equivalent to the actual rail current, which varies from point to point. It is thus shown that the disturbance increases with the length of the tramway, and for a tramway of given length the disturbance is a maximum at points on a line perpendicular to and bisecting it. Experiments made at Stockton on the magnitude of the disturbing force gave, with the vertical force instrument, a leakage of 16.3 per cent., and with the horizontal force instrument a leakage of 15.9 per cent., a fairly close agreement. The assumption that the terminals of the line are above and below the average potential of the earth by the same amount respectively, and that the leakage at any point is proportional to the potential difference between the rail and the earth, leads to the ordinary theory of a Fourier bar. This more accurate assumption has been developed and applied to the results obtained at Stockton. The leakage, as calculated from the amperes and volts, comes out as 20 per cent. The calculation of the disturbing vertical force gives  $10.5 \times 10^{-6}$  C.G.S. units, which is in fair agreement with the value  $7 \times 10^{-6}$  actually observed. In conclusion, it is pointed out that for practical purposes it is sufficient to deal with the average return current through the rails, the formulæ for which are quite simple.—Dr. R. T. Glazebrook read some notes on the practical application of the theory of magnetic disturbances by earth currents. In this paper the author has thrown the extended formula obtained by Prof. Rücker in the previous paper into a workable form, and has tabulated numbers which show at what distances the disturbances are negligible for tramways of different lengths.—Prof. R. Threlfall exhibited a quartz-thread gravity balance. Prof. Threlfall gave a short description of this instrument, which has been described in full elsewhere. He drew attention particularly to its accuracy and portability. Mr. Simpson asked how far the fibre had been calibrated, and